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INDOOR AIR QUALITY SAMPLING AND ANALYSIS PLAN SOLID WASTE MANAGEMENT UNIT 16 (SWMU 16) BUILDING 146 NSA CRANE IN

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NAVFAC MIDWEST

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-04-D-0055

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Indoor Air Quality Sampling and Analysis Plan for SWMU 16 - Building 146

Naval Surface Warfare Center Crane
Crane, Indiana

Contract Task Order F271

June 2008

NAVFAC Naval Facilities Engineering Command
Midwest
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, Illinois 60088

TETRA TECH NUS, Inc.

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INDOOR AIR QUALITY
SAMPLING AND ANALYSIS PLAN
FOR
SWMU 16 - BUILDING 146

NAVAL SURFACE WARFARE CENTER CRANE
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command
Midwest
201 Decatur Avenue
Building IA, Code EV
Great Lakes, Illinois 60088

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1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
cis-1,2-DCE	cis-1,2-dichloroethene
COC	contaminant of concern
DRI	direct reading instrument
EPA	United States Environmental Protection Agency
ER	exception report
FD	field duplicate
GC	gas chromatograph
IAQ	indoor air quality
ID	identification
IDEM	Indiana Department Environmental Management
IN	inside the building
LRC	Laboratory Review Checklist
MS	mass spectrometry
NSWC	Naval Surface Weapons Center
OSHA	Occupational Safety and Health Administration
OT	outside of building
PELs	Permissible Exposure Limts
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recover Act
RFI	Remedial Facility Investigation
SAP	Sampling Analysis Plan
SOP	Standard Operating Procedure
SWMU	Solid Waste Management Unit
TCE	trichloroethene
Tetra Tech	Tetra Tech NUS, Inc.
VC	vinyl chloride
VIM	voluntary interim measure
VOCs	volatile organic compounds

1.0 INTRODUCTION

To support investigation efforts relating to the Draft Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) Report for SWMU 16 at the Naval Surface Weapons Center (NSWC) Crane, the United States Environmental Protection Agency (EPA) has recommended that an indoor air quality (IAQ) sampling analysis be performed to determine if trichloroethene (TCE) identified in the groundwater might be migrating to the indoor air in Building 146 and to the surrounding area.

This IAQ Sampling Analysis Plan (SAP) details the field and laboratory activities and related procedures that will be performed during sampling event. The site investigation activities will be performed by Tetra Tech NUS, Inc. (Tetra Tech).

1.1 BACKGROUND

SWMU 16, approximately 16 acres in size, is located in the north-central portion of NSWC Crane. Building 146 is located within SWMU 16 and is used as an explosives fill and washout facility. Prior to the early 1990's, Building 146 included three oil-fired rotary kiln incinerators and was used for ammunition demilitarization operations. In 1995, a voluntary interim measure (VIM) was conducted to measure, remove and dispose of soils and sludge contaminated with lead, explosives, and TCE. As a result of the VIM, high levels of TCE were discovered. Additional field investigations and conceptual site models concluded that the upper zone of groundwater has been contaminated with explosives and chlorinated volatile organic compounds (VOCs) primarily TCE and 1,1,2-trichloroethane (1,1,2-TCA) and their degradation products.

VOCs in groundwater can evaporate, and move through the soil, and potentially enter a building through cracks in the foundation and floor, gaps around pipes, or other openings to the surface. The concentration of these compounds will lessen with distance from a groundwater source. Obstructions to the natural vapor flow of contaminant of concern (COC) in groundwater (e.g., cement floors and foundations) can further inhibit the accumulation of VOC concentrations inside of buildings.

VOC concentrations can be measured with a direct reading instrument (DRI) and can be supplemented by collecting and analyzing air samples using evacuated canisters. To assess air contaminants more thoroughly, air sampling devices equipped with appropriate collection media may be placed at various locations throughout the area and on persons with at-risk occupations. These samples provide air quality information for the period of time for which they are collected, and can indicate contaminant types and concentrations over the sampling period. As data is obtained (from the analysis of samples, DRIs, knowledge about materials involved, site operations, and the potential for airborne toxic hazards),

adjustments can be made in the types of samples, number of samples collected, frequency of sampling, and analysis required.

1.2 AIR SAMPLING AND ANALYSIS PLAN

This IAQ SAP describes sampling strategy, proposed sampling locations, sample identification (ID), sampling procedures, sampling methods, and quality assurance procedure pertaining to acquisition of chemical data. The Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Compendium Method to TO-15 was used as a guide to establish procedures for the selection of sampling apparatus and collection protocol.

1.2.1 Air Sampling Plan

Air Sampling Strategy

Air samples will be taken at strategic locations inside Building 146 to identify potential sources of contamination especially those that may permeate from the groundwater, through the soils, into the crawl space area beneath the floor, and, eventually, into the interior sections of the building.

Many chemicals in buildings possibly originate from sources other than groundwater. Therefore, to properly discern potential sources of contamination, outdoor ambient air samples will be collected and evaluated to determine background concentrations of the COCs.

Data collected from this investigation will be used to confirm whether a migration of TO-15 VOCs from groundwater have propagated into ambient air and poses a potential human health risk.

Proposed Air Monitoring Locations and Number of Samples

Both outdoor air and indoor air concentrations of TCE and TCE degradation by-products [cis-1,2-dichloroethene (cis-1,2-DCE), vinyl chloride (VC), 1,1-dichloroehtane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), and chloroethane] will be obtained by collecting air samples and conducting analysis at a Navy approved analytical laboratory. There will be a total of 10 samples: 5 indoor samples (one per each room inside of Building 146), 1 near where a steam heat piping is installed through the concrete floor, 1 where large cracks or gaps appear in the floor, 1 inside of an office, 1 located outside, and 1 co-located field duplicate. The proposed sampling locations are shown in Figure 1. The proposed outdoor sampling location will be located at a minimum of 15 feet upwind of Building 146 and sampling will begin approximately 1-2 hours before the indoor air sampling.

Household cleaning products (e.g., toilet cleaners, window cleaning products, and drain openers), degreasers, and lubricating solvents may contain ingredients that can bias the results of the air sampling by providing false positive detections. Therefore, all of these products will be removed from Building 146 at least 48 hours before the sampling begins and the building will be vented with ambient air to remove the residual vapors from any cleaning products. Building 146 will be closed from 24 to 48 hours prior to sampling. All windows and exterior doors will be closed. Where possible, any interior doors in between rooms will be closed so as to restrict interior air flow from one room to another. Roof or wall vents and fans will be turned off or temporarily rendered inoperable. Access inside Building 146 will be denied during air sampling.

At the same time when the indoor air is being sampled, one sampler will be placed outside to collect an ambient air sample**.** Air samplers (canisters) will be placed at a height that simulates the breathing zone, approximately 4 to 5 feet above ground surface. However, samplers placed in locations to determine if vapors are penetrating through openings in the floor will be placed closest to the opening.

Sample Identification

The sample identification scheme presented below will be used to identify and label all air samples collected during the field activities. The sample identification procedure will be used for all sample labels and chain-of-custody documents in order to maintain consistency in the labeling process and to allow efficient handling of all samples from different locations. The sampling numbers are assigned as follows:

146ASXXNN

Where

- **146** - Refers to the building which the samples are to be collected.
- **AS** - air sample
- **XX** - refers to the location of the sample [i.e., inside the building (IN), outside of building (OT), or field duplicate (FD)].
- **NN** - refers to the number sample collected.

For example, the sample identification for the first indoor air sample collected from the Building 146 would be identified as”146ASIN01."

The following table shows the sample identification and associated location:

Sample Identification	Sample Location
146ASIN01	Center of Room 1
146ASIN02	Center of Room 2
146ASIN03	Center of Room 3
146ASIN04	Center of Room 4
146ASIN05	Center of Room 5
146ASIN06	Near Heater Piping in Southeast Corner of Room 5
146ASIN07	Interior Office in Room 2
146ASIN08	Near Hose Connection in Western Corner of Room 1
146ASOT01	Outside Sample Location
146ASFD01	Field Duplicate (Location to be determined)

Sampling Procedures

Before you get to the field:

(1) Verify contents of the shipped package from the laboratory containing the correct number of Summa canisters, 8-hour regulators and filters and chain-of-custody forms. Ensure that serial numbers that appear on the shipping manifest match the serial numbers on canisters and regulators. Inspect each canister and regulator for damage or defects that could compromise the sampling effort. If any damage or defects are detected, notify the laboratory immediately and request replacement equipment.

(2) Store canisters and regulators in the clean, dry location prior to sampling.

(3) Ensure that the BIOS flow meter is fully charged.

When ready to sample:

(1) Ensure that the canister valve is closed.

(2) Remove brass dust cap from canister.

(3) Verify with the manufacturer recommendations regarding the order of attaching the collection devices to the canister,

(4) If a filter is required, attach the filter (according to manufacturer specifications) to the top of the canister by using a wrench (usually 9/16 inch) (be careful not to over-tighten the filter).

(5) Attach regulator to the top of the filter by using a wrench (usually 9/16 inch) (be careful not to over-tighten the regulator).

(6) Place canister in the desired location identified in Figure 1.

Determine the average flow-rate using the BIOS flow meter:

(1) Ensure that one end of the tubing is attached to the outlet port of the flow meter
(2) Attach the other end of the tubing to the open end of the regulator.
(3) Turn the flow meter on by pressing the “ON” button.
(4) Open the canister.
(5) Press the “READ” button.
(6) Take three consecutive readings and note the average flow rate in ml/min off the screen of the BIOS flow meter.
(7) Ensure that the average flow rate is within ±10 percent of 10.4 milliliters per minute (ml/min).
(8) Close valve on canister.
(9) Remove tubing from open end of regulator.
(10) Zero out the flow meter before proceeding to the next canister.
(11) Repeat for each canister to be used in the sampling effort.

To start sampling:

(1) Open canister by turning the valve counter-clockwise until it stops.
(2) Record the vacuum gauge pressure on the regulator.
(3) Record time and date.
(4) Record the current meteorological conditions (i.e., temperature, wind speed, wind direction, sky cover, and if any precipitation is occurring).
(5) Record any significant event at the time of sampling (i.e., heavy vehicle traffic, dusty conditions, etc,).
(6) Complete the sample label tag to include, but not limited to, sample ID number, date, time, field technician.

At end of sampling interval:

(1) Obtain an average flow rate at the end of the sampling event.
(2) Attach the open end of the BIOS flow meter tubing to the open end of the regulator.
(3) With canister valve open, collect three consecutive readings, if possible, and record the average flow rate.
(4) Record the final vacuum from the gauge on the regulator.
(5) Zero out the flow meter before proceeding to the next canister.
(6) Close the valve on the canister by turning it clockwise.
(7) Record the current time, meteorological conditions, any significant events, and complete the sample label tags.

(8) Disconnect the filter and regulator from the canister.
(9) Replace the brass dust cap on the canister and tighten.
(10) Record all pertinent information in the field log book.
(11) Return canister in boxes provided.
(12) Return sample media in package provided.
(13) Fill out chain-of-custody and relinquish samples properly.
(14) Place chain-of-custody in box and retain pink copy.
(15) Tape box shut and affix custody seal (if applicable) across flap.
(16) Ship the boxes via FedEx for overnight delivery.

The flow controller will be pre-set prior to shipment by the vender. For the 6 liter (L) canister, 8 hours sample interval, the flow rate will be set at 10.4 ml/min, and the target fill volume for 6 L canister is 5 L.

All indoor and outdoor air samples will be collected over 8-hour time period with an evacuated 6-liter SUMMA Canister with filter. Approximately 8 hours after installing the canister, the valve will be closed, and these canisters will be packed in the original box and shipped via FedEx to the Navy approved analytical laboratory for sample analysis. Sample hold time to analysis for a canister is 14 to 30 days for VOCs.

1.2.2 Sampling Analysis

Modified EPA Method TO-15 – Volatile organic compounds by gas chromatograph (GC)/mass spectrometry (MS) full-scan mode for TCE and TCE degradation by-products will be used for the analysis. Only analytical results from canisters individually certified will ultimately meet the highest level of data defensibility. The analytical laboratory standard operating procedure for TO-15 analysis is provided in Appendix A.

1.3 QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC)

Laboratory analysis will be conducted in accordance with appropriate analytical method. Internal laboratory QC checks include spike addition and analysis as well as reagent blanks generation and analysis.

The goal of the laboratory quality assurance program is to ensure the generation of scientifically valid and defensible data of known and proven quality. The laboratory will maintain basic method performance data to demonstrate the laboratory capability for performing the methods.

Laboratory blank, continuing calibration, laboratory control samples, surrogates and sample duplicates are required and must conform to method requirements.

Holding time compliance will be carefully monitored through internal laboratory procedures and will be reviewed by data quality assessment chemists.

The laboratory data package will contain a signature page, the Laboratory Review Checklist (LRC), any associated exception reports (ERs), the reportable data, and any supporting data as required.

1.4 SAMPLE MANAGEMENT

The procedures for proper management of air samples to be collected throughout the course of the assessment are discussed in the following subsections.

The following record keeping items will be used to document sample collection and handling:

- Chain-of-custody records,
- Sample Data Sheets and/or Field Log Book,
- Freight bills for samples shipped via an overnight carrier
- Analytical reports.

All air samples collected during the course of the field investigation will be placed in appropriate laboratory-supplied containers during transport to the analytical laboratory.

- Security of the Sample in the Field and in the Building. Field personnel will make the best effort to assure that the sampling area does not allow public access. Samples, once collected, will be in the possession of the sampling crew until shipped to the laboratory via FedEx overnight.

- Security of the Sample in the Laboratory. Samples will be stored in a secure area in the laboratory with limited access. Upon receipt of the samples, laboratory personnel will check the condition of the samples, and the accuracy of the accompanying paperwork.

The following chain-of-custody procedures are intended to document sample possession from the time of sample collection until ultimate disposal of the sample. For the purposes of these procedures, a sample is considered to be in custody if it is:

- In one's actual possession,
- In view after being in one's possession,
- Secured (i.e., locked up) so that no one can tamper with it, or
- In a secured area, available to authorized personnel only.

- A chain-of-custody record will be completed in the field. The original will accompany the samples, and copies will be maintained at intermediate steps.
- Deliver the shipping container(s) to an overnight carrier for shipment.

1.5 DATA VALIDATION

Analytical data package will be evaluated and validated based on any applicable Indiana Department Environmental Management (IDEM) data packaging and reporting requirements. A data validation report will be provided with the data report. The data validation process will provide:

- Comparison of the data package to the reporting level requirements to ensure completeness in the analytical data package and compliance with the contract.

- Comparison of sampling dates, sample extraction dates, and analysis dates to ensure that samples were extracted and analyzed within the proper holding times.

- Checks of QA/QC samples (laboratory blanks) to evaluate possible contamination sources.

1.6 ANALYTICAL DATA

Laboratory data reduction procedures are those specified in SW-846 and those described in the laboratory Standard Operating Procedures.

The laboratory will prepare and retain full analytical and QC documentation. The laboratory will report the data along with QC supporting data.

Standard forms will be used, preferably SW-846 recommended format. Copies of preparation log, runlog, and raw data (i.e., instrumentation, calibration information, and chromatographs) shall be provided by the analytical laboratory. The data will be validated by Tetra Tech to ensure its usability.

Tetra Tech will prepare and submit a report upon completion of laboratory analytical activities. The report will provide a brief overview of the areas investigated and samples collected. A presentation of the findings of the air sampling in terms of site observations, and comparison of results to applicable regulatory standards will be included. Tables and figures will be used as appropriate to augment the report text.

Table 1 contains the Occupational Safety and Health Administration (OSHA) Standards for workplace Permissible Exposure Limits (PELs) for TCE and TCE degradation by-products.

TABLE 1

PERMISSIBLE EXPOSURE LIMITS FOR TCE AND TCE DEGRADATION BY-PRODUCTS
NSWC CRANE
CRANE, INDIANA

PEL	
mg/m^3	**ppm**
TCE (CASRN: 79-01-6)	
537	100
cis-1,2-DCE (CASRN: 156-59-2)	
790	200
VC (CASRN: 75-01-4)	
2.56	1
1,1-DCA (CASRN: 75-34-3)	
400	100
1,1-DCE (CASRN: 75-35-4)	
4	1
Chloroethane (CASRN: 75-00-3)	
2600	1000

1,1-DCA - 1,1-dichloroethane.
1,1-DCE - 1,1-dichloroethene.
CASRN - Chemical Abstract Services Registry Number.
cis-1,2-DCE - cis-1,2-dichloroethene.
mg/m^3 - millgrams per cubic meter.
PEL - Permissible Exposure Limit.
ppm - parts per million.
TCE - trichloroethene.
VC - vinyl chloride.

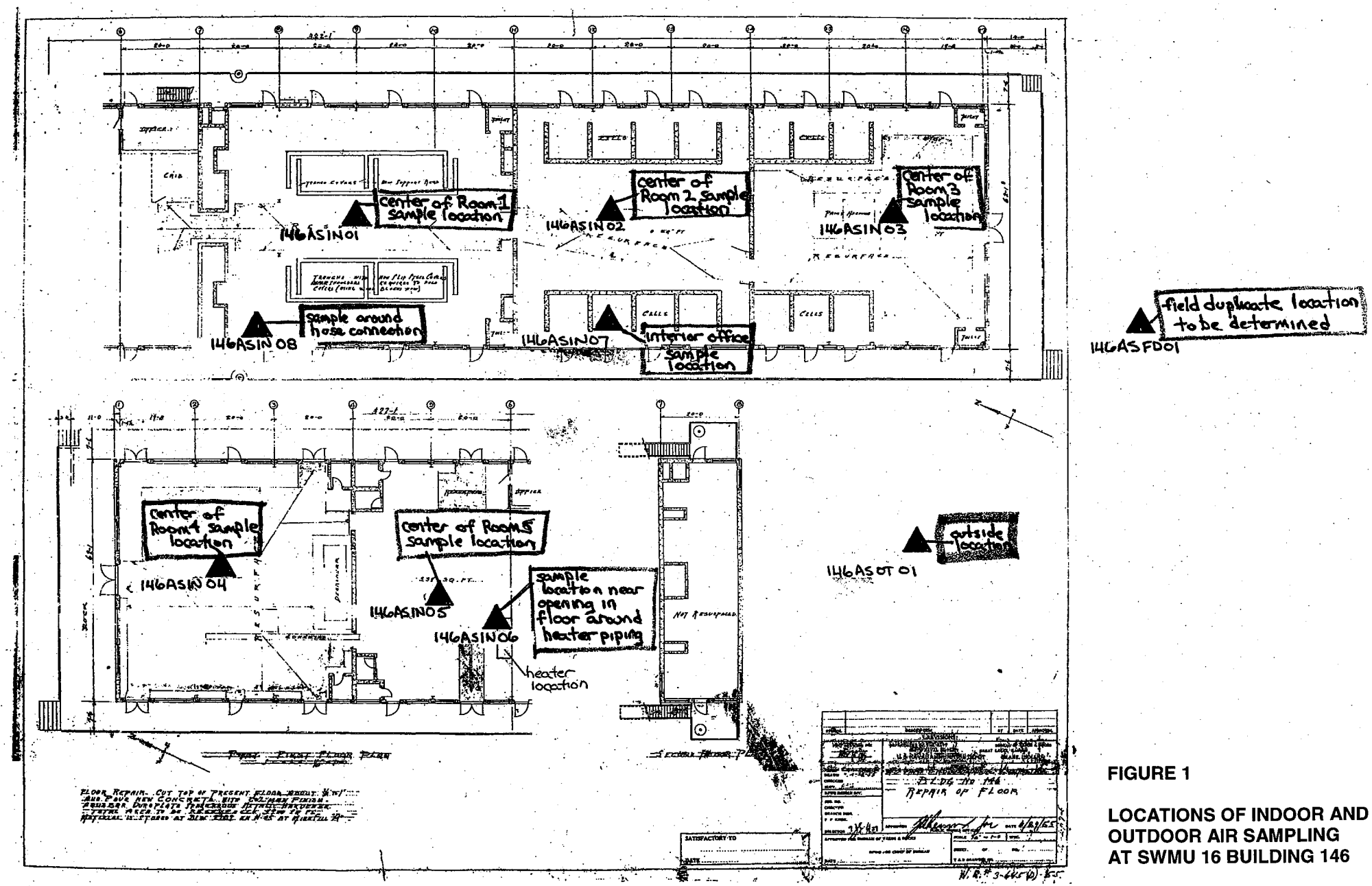

FIGURE 1

LOCATIONS OF INDOOR AND OUTDOOR AIR SAMPLING AT SWMU 16 BUILDING 146

APPENDIX A

ANALYTICAL LABORATORY STANDARD OPERATING PROCEDURES FOR TO-15 ANALYSIS

8.0 TO-14A/TO-15 – VOLATILE ORGANIC COMPOUNDS

This method involves full scan GC/MS analysis of whole air samples collected in evacuated stainless steel canisters. Samples are analyzed for volatile organic compounds using EPA Method TO-14A/TO-15 protocols. An aliquot of the sample is withdrawn from the canister through a mass flow controller and is either concentrated using a cryogenic trap and/or concentrated using a hydrophobic multisorbent bed. The hydrophobic multisorbent bed functions as a drying system which removes water from the sample stream prior to analysis by full scan GC/MS. For low level analysis, the sample is focused onto a cryogenic cooled column for analysis by full scan GC/MS.

Air Toxics Ltd. performs a modified version of this method. The method modifications, standard target analyte list, Limit of Quantitation, QC criteria, and QC summary can be found in the following tables.

Table 8-1. Summary of Method Modifications

Requirement	TO-14A	TO-15	Air Toxics Ltd. Modifications
Sample Drying System	Nafion Drier.	Multisorbent.	Multisorbent.
Blank acceptance criteria	< 0.2 ppbv.	< RL.	< RL.
Blanks and standards **(applies to Low Level analysis only)**	Zero Air.	Zero air.	Nitrogen.
BFB absolute abundance criteria	Within 10% of that from the previous day.	Not mandated.	CCV internal standard area counts are compared to ICAL, corrective action for > 40 %D.
Method Detection Limit	Not Specified.	Follow 40CFR Pt.136 App. B.	The MDL met all relevant requirements in Method TO-15 (statistical MDL less than the LOQ). The concentration of the spiked replicate may have exceeded 10X the calculated MDL in some cases.
Initial Calibration	≤ 30 % RSD.	≤ 30 % RSD with 2 compounds allowed out to ≤ 40 % RSD.	≤ 30 % RSD with 2 compounds allowed out to ≤ 40 % for **QUAD and 5&20** analysis and 4 compounds allowed out to ≤ 40 % for **Low Level** analysis.

Requirement	TO-14A	TO-15	Air Toxics Ltd. Modifications
Daily CCV	≤ 30% D.	≤ 30% D.	For **QUAD and 5&20** analysis: 70-130%. Compounds exceeding this criterion and associated data will be flagged and narrated. If more than two compounds from the standard list recover outside of 70-130%, corrective action will be taken. Unless prior client approval; under no circumstances will samples be analyzed if any compound exceeds 60-140%. For **Low Level** analysis the above applies except corrective action will be taken if more than four compounds from the standard list recover outside of 70-130%.
Sample collection media.	Summa canister.	Summa canister.	Methods TO-14A/TO-15 are validated for samples collected in specially treated canisters. As such, the use of Tedlar bags for sample collection is outside the scope of these methods and not recommended for ambient or indoor air samples. Associated results are considered qualified.

Table 8-2. Method TO-14A/TO-15 Analyte List

Analyte	RL (ppbv) TO-15/ LL/5&20	%RSD	Acceptance Criteria	
			LCS (%R)	Precision Limits (Max. RPD)
1,1,2,2-Tetrachloroethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,1,2-Trichloroethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,1-Dichloroethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,1-Dichloroethene	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,2,4-Trichlorobenzene	2.0/0.5/20	30%	70 - 130	≤ 25
1,2,4-Trimethylbenzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,2-Dibromoethane (EDB)	0.5/0.1/5.0	30%	70 - 130	≤ 25

Analyte	RL (ppbv) TO-15/ LL/5&20	%RSD	Acceptance Criteria	
			LCS (%R)	Precision Limits (Max. RPD)
1,2-Dichlorobenzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,2-Dichloroethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,2-Dichloropropane	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,3,5-Trimethylbenzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,3-Dichlorobenzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
1,4-Dichlorobenzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Benzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Bromomethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
Carbon Tetrachloride	0.5/0.1/5.0	30%	70 - 130	≤ 25
Chlorobenzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Chloroethane	0.5/0.1/5.0	30%	70 - 130	≤ 25
Chloroform	0.5/0.1/5.0	30%	70 - 130	≤ 25
Chloromethane	2.0/0.1/20	30%	70 - 130	≤ 25
Chlorotoluene (Benzyl Chloride)	0.5/0.1/5.0	30%	70 - 130	≤ 25
cis-1,2-Dichloroethene	0.5/0.1/5.0	30%	70 - 130	≤ 25
cis-1,3-Dichloropropene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Dichloromethane	0.5/0.2/5.0	30%	70 - 130	≤ 25
Ethylbenzene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Freon 11 (Trichlorofluoromethane)	0.5/0.1/5.0	30%	70 - 130	≤ 25
Freon 113 (Trichlorotrifluoroethane)	0.5/0.1/5.0	30%	70 - 130	≤ 25
Freon 114	0.5/0.1/5.0	30%	70 - 130	≤ 25
Freon 12 (Dichlorodifluoromethane)	0.5/0.1/5.0	30%	70 - 130	≤ 25
Hexachlorobutadiene	2.0/0.5/20	30%	70 - 130	≤ 25
m,p-Xylene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Methyl Chloroform	0.5/0.1/5.0	30%	70 - 130	≤ 25
o-Xylene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Styrene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Tetrachloroethene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Toluene	0.5/0.1/5.0	30%	70 - 130	≤ 25
trans-1,3-Dichloropropene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Trichloroethene	0.5/0.1/5.0	30%	70 - 130	≤ 25
Vinyl Chloride	0.5/0.1/5.0	30%	70 - 130	≤ 25

Table 8-3. Method TO-14A/TO-15 Analyte List

Analyte	RL (ppbv) TO-15/ LL/5&20	%RSD	Acceptance Criteria	
			LCS (%R)	Precision Limits
1,3-Butadiene	0.5/0.1/5.0	30%	60 – 140	≤ 25
1,4-Dioxane	2.0/0.1/20	30%	60 – 140	≤ 25
2-Butanone (Methyl Ethyl Ketone)	0.5/0.1/5.0	30%	60 – 140	≤ 25
2-Hexanone	2.0/0.5/20	30%	60 – 140	≤ 25
4-Ethyltoluene	0.5/0.1/5.0	30%	60 – 140	≤ 25
4-Methyl-2-Pentanone (MIBK)	0.5/0.1/20	30%	60 – 140	≤ 25

Analyte	RL (ppbv) TO-15/ LL/5&20	%RSD	Acceptance Criteria	
			LCS (%R)	Precision Limits
Acetone	2.0/0.5/20	30%	60 – 140	≤ 25
Bromodichloromethane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Bromoform	0.5/0.1/5.0	30%	60 – 140	≤ 25
Carbon Disulfide	0.5/0.5/5.0	30%	60 – 140	≤ 25
Cyclohexane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Dibromochloromethane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Ethanol	2.0/0.5/20	30%	60 – 140	≤ 25
Heptane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Hexane	0.5/0.1/5.0	30%	60 – 140	≤ 25
Isopropanol	2.0/0.5/20	30%	60 – 140	≤ 25
Methyl t-Butyl Ether (MTBE)	0.5/0.1/5.0	30%	60 – 140	≤ 25
Propylene	2.0/0.5/20	30%	60 – 140	≤ 25
Tetrahydrofuran	0.5/0.5/5.0	30%	60 – 140	≤ 25
trans-1,2-Dichloroethene	0.5/0.1/5.0	30%	60 – 140	≤ 25
2,2,4-Trimethylpentane	0.5/0.5/5.0	30%	60 – 140	≤ 25
Cumene	0.5/0.1/5.0	30%	60 – 140	≤ 25
Propylbenzene	0.5/0.1/5.0	30%	60 – 140	≤ 25
3-Chloroprene	2.0/0.5/20	30%	60 – 140	≤ 25
Naphthalene	2.0/0.5/20	30%	60 – 140	≤ 25
TPH (Gasoline) or NMOC (Hexane/Heptane)	10/2.0/50	One Point Calibration	NA	≤ 25

Table 8-4. Internal Standards

Analyte	Accuracy (% R)
Bromochloromethane	60 - 140
1,4-Difluorobenzene	60 - 140
Chlorobenzene-d_5	60 - 140

Table 8-5. Surrogates

Analyte	Accuracy (% R)
1,2-Dichloroethane-d_4	70 – 130
Toluene-d_8	70 – 130
4-Bromofluorobenzene	70 – 130

Table 8-6. Summary of Calibration and QC Procedures for Methods TO-14A/TO-15

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Tuning Criteria	Every 24 hours, or every 12 hours if project requires.	SW – 846 tune criteria.	Correct problem then repeat tune.
5-Point Calibration	Prior to sample analysis.	% RSD ≤ 30 with two compounds allowed out to ≤ 40% RSD for QUAD and 5&20 (4 allowed out for LL).	Correct problem then repeat Initial Calibration Curve.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
LCS	After each initial calibration curve, and daily, prior to sample analysis.	Recoveries for 90% of "Standard" compounds must be 70-130%; for 80% of "Non-standard" compounds, recoveries must be 60-140%. No recovery may be <50%. * If specified by the client in-house generated control limits may be used.	Check the system and reanalyze the standard. Re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.
Continuing Calibration Verification (CCV)	At the start of each day and, if required by a specific project, every 12 hours.	For QUAD and 5&20: 70-130%. Compounds exceeding this criterion and associated data will be flagged and narrated with the exception of high bias associated with non-detects. If more than two compounds from the standard list recover outside of 70-130%, corrective action will be taken. Unless prior client approval; under no circumstances will samples be analyzed if any compound exceeds 60-140%. For **Low Level** analysis the above applies except corrective action will be taken if more than four compounds from the standard list recover outside of 70-130%.	Perform maintenance and repeat test. If the system still fails the CCV, perform a new 5 point calibration curve.
Laboratory Blank	After the CCV/LCS.	Results less than the laboratory reporting limit.	Inspect the system and Re-analyze the blank.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Internal Standard (IS)	As each standard, blank, and sample is being loaded.	Retention time (RT) for blanks and samples must be within ±0.33 min of the RT in the CCV and within ±40% of the area counts of the daily CCV internal standards.	**For blanks:** inspect the system and reanalyze the blank. **For samples:** re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.
Surrogates	As each standard, blank, and sample is being loaded.	70 - 130%. * If specified by the client in-house generated control limits may be used.	**For blanks:** inspect the system and reanalyze the blank. **For samples:** re-analyze the sample unless obvious matrix interference is documented. If the %R is within limits in the re-analysis, report the second analysis. If %R is out-of-limits a second time, then narrate results.
Laboratory Duplicates	10% of the samples.	RPD ≤25% for detections >5 X's the RL.	Re-analyze the sample a third time. If the limit is exceeded again, investigate the cause and bring the system back to working order. If no problem is found on the system, narrate results.